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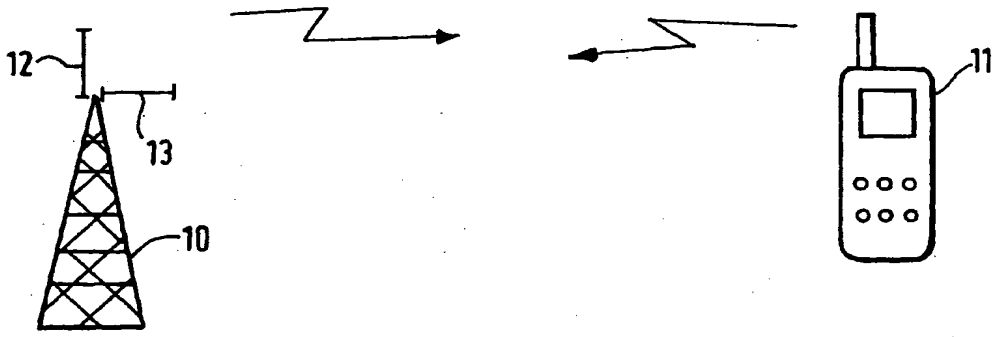
(54) Title: A RADIOTELEPHONE SYSTEM



(57) Abstract: A radiotelephone system comprising a transmitter station (10) and a mobile station (11) provided with means for receiving a signal transmitted by the transmission station and measurement means for measuring the quality of the received signal. The transmitter station (10) has first and second antennas (12 and 13) having different polarisation properties. The transmitter station (10) is arranged to transmit the same signal from each of the antennas (12 and 13).

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A Radiotelephone System

This invention relates to a radiotelephone system, and in particular a radio telephone system comprising a transmitter station and a mobile station.

Cellular telephones and the like often experience rapid changes in received signal power, especially when moving in urban environments, as a result of multipath propagation. This is a well known phenomenon, and modern cellular systems utilise many techniques to minimise the negative effects caused by it. One such technique involves the provision of two antennas at a base station, the antennas being separated by a distance of, typically, one or two metres. This operates on the presumption that a mobile station experiencing a null with respect to signals received from one antenna is unlikely also to experience a null with signals transmitted from the other antenna. This technique is known as space-time transmitter diversity (STTD).

It is an aim of this invention to provide another means by which the negative effects of multipath propagation can be mitigated.

The present invention provides a radiotelephone system comprising a transmitter station and a mobile station provided with means for receiving a signal transmitted by the transmission station and measurement means for measuring the quality of the received signal, wherein the transmitter station has first and second antennas having different polarisation properties, the transmitter station being arranged to transmit the same signal from each of the antennas.

Preferably, the mobile station is arranged to transmit a signal indicative of the quality or a change in quality to the transmitter station or another station forming part of the system.

In a preferred embodiment, the two antennas are arranged to transmit signals whose polarisation properties are separated from each other by substantially 90°, and

preferably the first antenna is arranged to transmit vertically-polarised signals, and the second antenna is arranged to transmit horizontally-polarised signals.

Advantageously, the transmitter station is provided with control means for controlling the power of the signal transmitted by each of the antennas. Preferably, the control means comprises a controller and first and second attenuators, the output of the first attenuator applied to the first antenna, and the output of the second attenuator being applied to the second antenna. The controller may be arranged to apply signals to the input of the two attenuators that are substantially twice the power of the signal to be transmitted by the transmitter station, and to control each of the attenuators so as to output signals attenuated by substantially 50%.

Conveniently, the measurement means comprises means for detecting the signal-to-interference ratio (SIR) of the received signal. Alternatively, the measurement means comprises means for detecting the bit error rate (BER) of the received signal. In this case, the measurement means is arranged to use a cyclic redundancy check (CRC).

Preferably, the mobile station further comprises transmission means for transmitting a signal indicative of the measured quality of the received signal to the transmitter station. In this case, the controller may be arranged to receive the signal indicative of the measured quality, and to control each of the attenuators to vary the attenuation of their output signals, whilst ensuring that the total power of the signal transmitted by the transmitter station remains substantially constant. Advantageously, the controller is arranged to increase the attenuation of one of the attenuators by a predetermined percentage of the total transmitted power, and to decrease the attenuation of the other attenuator by the same percentage.

The invention also provides a method of operating a radio telephone system comprising a transmitter station having first and second antennas with different polarisation properties, and a mobile station provided with means for measuring the quality of a signal received from the transmission station, the method comprising the steps of:

a) transmitting the same signal from each of the antennas;

b) transmitting a signal from the mobile station to the transmitter station indicative of the measured quality of the signal received by the mobile station; and

c) varying the signal subsequently transmitted by the antennas of the transmitter station in dependence upon the received signal indicative of the measured quality.

Preferably, the method further comprises the step of attenuating the signals sent by each of the antennas.

In a preferred embodiment, the method further comprises the step of varying the attenuation of each of the attenuators in dependence upon the received signal indicative of the measured quality, the variation in attenuation being such that the total power of the signal transmitted by the transmitter station remains substantially constant.

An embodiment of the invention will now be described, by way of example, with reference to the drawings, in which:

Figure 1 is a schematic diagram of a radiotelephone system embodying the invention; and

Figure 2 is a schematic diagram of part of a base station of the radiotelephone system of Figure 1.

Referring to the drawings, Figure 1 shows a radiotelephone system in the form of a cellular telephone system, the system comprising a base station 10 in two-way communication with a mobile station 11. The base station 10, which constitutes a transmitter station, includes first and second antennas 12 and 13, which are arranged at 90° to one another, so that the first antenna transmits signals with a vertical polarisation, and the second antenna transmits signals with a horizontal polarisation. The antennas 12 and 13 are each connected to base station circuitry, which is shown in Figure 2.

Figure 2 shows part of the base station 10 schematically, the base station comprising first and second controllable attenuators 20 and 21, outputs of which are connected to the antennas 12 and 13 respectively, a controller 22 and a processor 23. Operation is as follows.

Signals which the base station 10 requires to be transmitted to the mobile station 11 are applied to inputs of the attenuators 20 and 21 via a signal input 24. The power of each of these signals is twice that which is required to be transmitted. Initially, the controller 22 controls each of the attenuators 20 and 21 to attenuate the signals received at its input by 50%. The power of the signal transmitted by the first antenna 12 is, therefore, the same as the power transmitted by the second antenna 13. The total power is equal to half of the input power; and is, therefore, the required transmission power. The signal transmitted is one-half vertically polarised and one-half horizontally polarised.

The mobile station 11 includes means to measure the quality of the received signal. Quality may be measured by detection of the SIR or the BER, which can be inferred using a CRC, or in any other way. The mobile station 11 then transmits a signal indicative of the measured quality to the base station 10, or to another base station (not shown) forming part of the radiotelephone system. This quality measurement is fed to the processor 23, which applies the measurement to an algorithm. In this embodiment, the algorithm is a simple one wherein the mix of the signals transmitted from the antennas 12 and 13 is either increased or decreased by 5% at random. The resulting percentage mix is fed to the controller 22, which controls the attenuators to adopt the appropriate attenuation. For example, the mix may be changed from 50% to 55%, in which case the controller 22 controls the first attenuator 12 to attenuate at 45%, and controls the second attenuator 13 to attenuate at 55%. The total transmitted power is the same, although 55% is vertically polarised and 45% is horizontally polarised.

The mobile station 11 then makes a further quality measurement, and transmits a signal indicative of it to the base station 10. If the processor 23 determines that the quality of the signal received at the mobile station 11 is improved, the above procedure is repeated, although with a starting point of 55%. If the quality remains constant or

decreases, the controller 22 controls attenuators to adopt the other possible mix, in this case a 45% mix. Using this algorithm, the base station 10 will tend towards transmitting a mix which gives an optimum or near optimum reception at the mobile station 11 for the given transmitted power.

Of course, numerous other schemes and algorithms for effecting control of the attenuators 20 and 21 are possible, and all are within the scope of this invention.

Instead of the mobile station 11 transmitting a signal indicative of the measured signal quality, it may transmit a signal indicative of whether the quality increased following a change in mix, whether it decreased or whether it did not change. For further simplification, a "did not change" condition may be considered as either an increase in quality or a decrease in quality, reducing the number of possible conditions which the mobile station 11 can signal to the base station 10.

In the above described embodiment, the polarisation properties of the antennas 12, 13 are separated from each other by 90° in the vertical-horizontal sense. It will be appreciated, however, that other arrangements are also within the scope of the invention, such as an arrangement in which one antenna has generally East-West polarisation and another antenna has generally North-South polarisation. Also, although polarisation separation of 90° or approximately 90° is optimum, the invention can also be performed using greater or lesser degrees of polarisation separation.

By transmitting at two different polarisations, the integrity of the communications link between the base station 10 and the mobile station 11 of the above embodiment is improved. This results in an increased likelihood of signals being correctly received at the mobile station 11.

Claims

1. A radiotelephone system comprising a transmitter station and a mobile station provided with means for receiving a signal transmitted by the transmission station and measurement means for measuring the quality of the received signal, wherein the transmitter station has first and second antennas having different polarisation properties, the transmitter station being arranged to transmit the same signal from each of the antennas.

2. A system as claimed in claim 1, wherein the mobile station is arranged to transmit a signal indicative of the quality or a change in quality to the transmitter station or to another station forming part of the system.

3. A system as claimed in claim 1 or claim 2, wherein the two antennas are arranged to transmit signals whose polarisation properties are separated from each other by substantially 90°.

4. A system as claimed in claim 3, wherein the first antenna is arranged to transmit vertically-polarised signals, and the second antenna is arranged to transmit horizontally-polarised signals.

5. A system as claimed in any one of claims 1 to 4, wherein the transmitter station is provided with control means for controlling the power of the signal transmitted by each of the antennas.

6. A system as claimed in claim 5, wherein the control means comprises a controller and first and second attenuators, the output of the first attenuator applied to the first antenna, and the output of the second attenuator being applied to the second antenna.

7. A system as claimed in claim 6, wherein the controller is arranged to apply signals to the input of the two attenuators that are substantially twice the power of the signal to be transmitted by the transmitter station, and to control each of the attenuators so as to output signals attenuated by substantially 50%.

8. A system as claimed in any one of claims 1 to 7, wherein the measurement means comprises means for detecting the SIR of the received signal.

9. A system as claimed in any one of claims 1 to 7, wherein the measurement means comprises means for detecting the BER of the received signal.

10. A system as claimed in claim 9, wherein the measurement means is arranged to use a CRC.

11. A system as claimed in any one of claims 1 to 10, wherein the mobile station further comprises transmission means for transmitting a signal indicative of the measured quality of the received signal to the transmitter station.

12. A system as claimed in claim 11 when appendant to claim 7, wherein the controller is arranged to receive the signal indicative of the measured quality, and to control each of the attenuators to vary the attenuation of their output signals, whilst ensuring that the total power of the signal transmitted by the transmitter station remains substantially constant.

13. A system as claimed in claim 12, wherein the controller is arranged to increase the attenuation of one of the attenuators by a predetermined percentage of the total transmitted power, and to decrease the attenuation of the other attenuator by the same percentage.

14. A method of operating a radio telephone system comprising a transmitter station having first and second antennas with different polarisation properties, and a mobile station provided with means for measuring the quality of a signal received from the transmission station, the method comprising the steps of:

a) transmitting the same signal from each of the antennas;

b) transmitting a signal from the mobile station to the transmitter station indicative of the measured quality of the received signal; and

c) varying the signal subsequently transmitted by the antennas of the transmitter station in dependence upon the received signal indicative of the measured quality.

15. A method as claimed in claim 14, further comprising the step of attenuating the signals sent by each of the antennas.

16. A method as claimed in claim 15, further comprising the step of varying the attenuation of each of the attenuators in dependence upon the received signal indicative of the measured quality, the variation in attenuation being such that the total power of the signal transmitted by the transmitter station remains substantially constant.

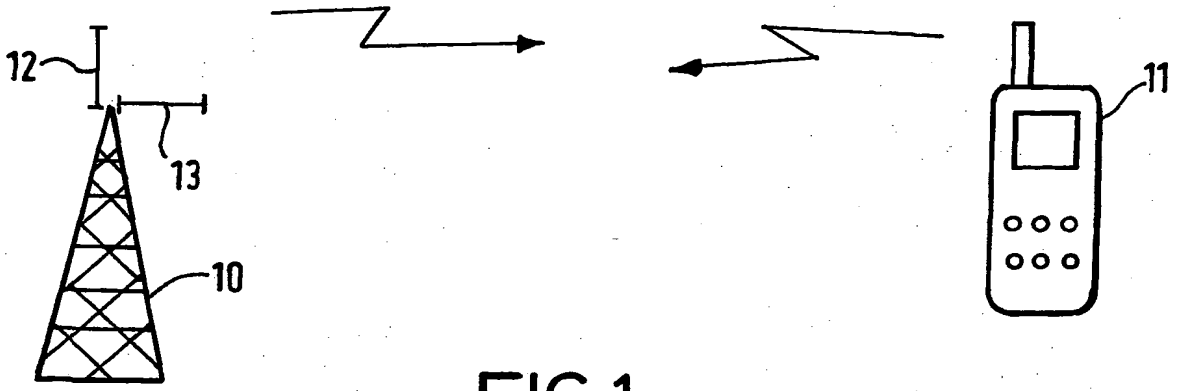

FIG.1.

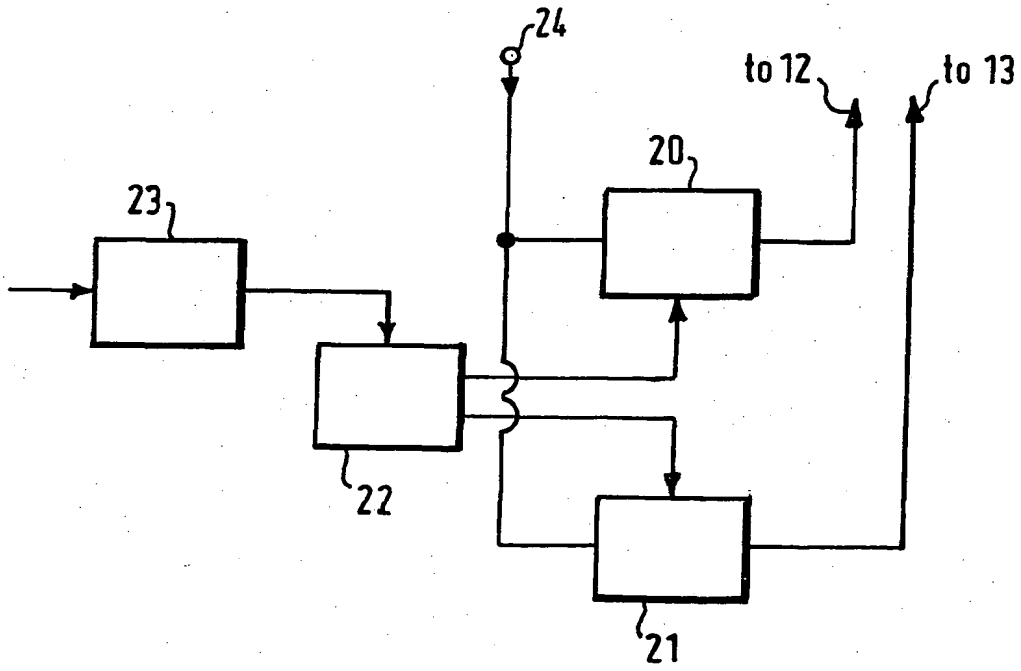

FIG.2.

INTERNATIONAL SEARCH REPORT

Int ɔnal Application No
PCT/GB 02/02757

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/10 H04B7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 01 54230 A (MOTOROLA INC) 26 July 2001 (2001-07-26) abstract page 7, line 1 - line 8 page 7, line 23 - line 27 page 8, line 20 - line 26 page 11, line 8 - line 15 page 12, line 15 -page 14, line 8 page 15, line 18 - line 29	1-5,11, 14
X	US 5 812 935 A (KAY STANLEY E) 22 September 1998 (1998-09-22)	1,2,5-7, 11-16
A	abstract column 2, line 7 - line 39 column 3, line 58 - line 67 column 5, line 52 - line 67 column 6, line 4 - line 29	3,8,9

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 August 2002	09/08/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lustrini, D

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INTERNATIONAL SEARCH REPORT

Int nal Application No
PCT/GB 02/02757

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 104 933 A (KRONESTAD FREDRIC ET AL) 15 August 2000 (2000-08-15) abstract column 4, line 21 - line 34 column 5, line 8 - line 16 column 5, line 36 -column 6, line 11	1-3,5,8, 9,11,14, 15

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int ›nal Application No
PCT/GB 02/02757

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0154230 A	26-07-2001	EP 1169750 A1	09-01-2002
		WO 0154230 A1	26-07-2001
US 5812935 A	22-09-1998	US 5542107 A	30-07-1996
US 6104933 A	15-08-2000	AU 7948898 A	04-01-1999
		EP 0997008 A2	03-05-2000
		JP 2002505819 T	19-02-2002
		WO 9859433 A2	30-12-1998
		TW 387176 B	11-04-2000